ENTOMOLOGICAL NEWS

MAY 1947

Vol. LVIII **No. 5**

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PUBLISHED MONTHLY, EXCEPT AUGUST AND SEPTEMBER, BY
THE AMERICAN ENTOMOLOGICAL SOCIETY
PRINCE AND LEMON STS., LANCASTER, PA.
AND
THE ACADEMY OF NATURAL SCIENCES, PHILADELPHIA 3, PA.

Subscription, per yearly volume of ten numbers: $3.00 domestic; $3.30 foreign; $3.15 Canada. Entered as second-class matter April 19, 1943, at the post office at Lancaster, Pa., under the Act of March 3, 1879. Acceptance for mailing at the special rate of postage prescribed for in Section 1, Act of October 3, 1917, authorized January 15, 1921.

ENTOMOLOGICAL NEWS

ENTOMOLOGICAL NEWS is published monthly, excepting August and September, by The American Entomological Society at 1900 Race Street, Philadelphia 3, Pa., U. S. A.

PHILIP P. CALVERT, Editor Emeritus. R. G. SCHMIEDER, Editor. Editorial Staff: E. T. CRESSON, JR., E. J. F. MARX, E. T. MOUL, J. A. G. REHN, and A. G. RICHARDS.

Subscription price, per yearly volume of 10 numbers: Domestic, $3.00; Foreign, $3.30; Canada, $3.15—U. S. Currency.

SUBSCRIPTIONS, ADVERTISEMENTS: All communications and remittances to be addressed to **ENTOMOLOGICAL NEWS, 1900 Race Street, Philadelphia 3, Pa.**

ADVERTISING RATES: Full width of page. Payments in advance.

	1 Inch	2 Inches	3 Inches	6 Inches
One Issue	$1.00	$ 1.90	$ 2.75	$ 4.80
Five Issues	4.50	8.50	12.00	21.00
Ten Issues	8.00	15.00	21.00	36.00

MANUSCRIPTS and all communications concerning same should be addressed to **R. G. Schmieder, Zoological Laboratory, University of Pennsylvania, Philadelphia 4, Pa.**

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ENTOMOLOGICAL NEWS

VOL. LVIII MAY, 1947 No. 5

The Relationship of the Neotropical Acridine Locust Genus Machaerocera (Orthoptera: Acrididae; Acridinae)

By JAMES A. G. REHN

Academy of Natural Sciences of Philadelphia

In 1859 the great orthopterist Henri de Saussure described under the name *Machaerocera* a rather unusual genus of locusts from Mexico, basing it on the then described *M. mexicana*.[1] His comment as to its affinities was vague and casual, and it was not until 1893 that we find any clearer indication of its relationship, when Brunner von Wattenwyl, in a generic key, placed it nearest to the western North American genus *Acrolophitus* of Thomas, with which it was briefly contrasted.[2] Dr. Lawrence Bruner in the Biologia Centrali-Americana, without comment, inserted *Machaerocera* in his generic key between *Acrocara* Scudder (now synonymized under the older *Pedioscirtetes* Thomas) and *Acrolophitus* on one hand, and *Gymnes* Scudder (now replaced by the prior *Bootettix* Bruner) on the other.[3] These references summarize the suggestions which have been made in the past as to the relationship of *Machaerocera*. In recent years the chromosomes of the latter genus have been studied by my friend Dr. E. R. Helwig, and the cytological conclusions [4]

[1] Revue et Magas. de Zool., (2) XI, p. 391 (1859).

[2] Ann. Mus. Civ. Stor. Nat. Genova, XXXIII, p. 120 (1893).

[3] Biol. Cent.-Amer., Orth., II, pp. 27, 49 (1904).

[4] "Unusual integrations of the chromatin in Machaerocera and other genera of the Acrididae (Orthoptera)." By Edwin R. Helwig. Journ. of Morph., 71, no. 1, pp. 1–26, pls. 1–3 (1942). (See specifically pp. 3–6.)

support others which slowly had been crystallizing, drawn from the external morphology, i.e., that *Machaerocera* holds an anomalous position as far as relationship with other American genera of the subfamily Acridinae is concerned.

There exists no modern classification of the genera of the world for the subfamily Acridinae, and in consequence no broad integration of the Old and New World genera has been attempted, and although basic study has been accomplished in a few genera groups, certain of the attempted correlations have left much to be desired. While we possess several arrangements of genera of the subfamily as occurring in portions of the New World, *Machaerocera* will be found only in those covering Mexico and Central America, and in none treating purely North or South American genera. We, however, do have a relatively recent comprehensive classification of the Old World genera by the late Dr. Ignacio Bolívar.[5]

A comparison of *Machaerocera,* which is relatively well-known and locally common over much of Mexico, with genera with which it has been associated in the literature, shows very clearly it is in no way related. The genera *Acrolophitus* and *Pedioscirtetes* are relatively close to one another in relationship, and together constitute the distinctive genera-group Acrolophiti, while *Bootettix* is the sole representative of an equally distinctive and peculiar North American and north Mexican genera-group, the Bootettiges. The latter group has a general facies resembling that of the Acrolophiti, but is at once separable by the male having the tegminal scapular field strongly dilated, the internal caudal tibial spurs with the flexor appreciably longer than the extensor, instead of the reverse as in the Acrolophiti, and in the caudal tarsi having the proximal article equal to less than half the entire tarsal length, instead of equalling or surpassing half the length, as in the Acrolophiti.[6]

[5] "Los Truxalinos del antiguo Mundo." Trab. Mus. Nac. Cienc. Nat., Madrid, Ser. Zool., núm. 20, pp. 41–110 (1914).

[6] The Bootettiges are virtually unique in possessing areas of mother-of-pearl (nacré) on various parts of the body chitin. For a discussion of *Bootettix*, its species, distribution and bionomics, see Rehn, ENTOM. NEWS, LV, pp. 158–164 (1944).

When we attempt to integrate the Acrolophiti and the Bootettiges with the Old World genera-groups, as set forth by I. Bolívar in 1914, we find the Acrolophiti would run to the Parapleuri (= Mecostethi as understood to-day), and the Bootettiges to the Chrysochraontes, to neither of which are the two exclusively American genera-groups in any way related.

In 1891 Ferdinand Karsch erected a genus *Holopercna,*[7] basing it on a single new species, *H. coelestis,* from the Cameroons, West Africa. The previous year Ignacio Bolívar had described a species *Duronia gerstaeckeri* from Ashanti,[8] which we now know is identical with Karsch's *Holopercna coelestis,* and hence *gerstaeckeri* is the older and valid specific name for this relatively common locust of the Lower Guinea Forest Subregion of West Africa. I have had the opportunity to collect both *Machaerocera* and *Holopercna,* and their general morphological resemblance, plus that most unusual feature for the subfamily of the mutual possession of blue wing disks, had impressed me on more than one occasion. Bolívar, in his key to the Old World genera, above mentioned, placed *Holopercna* in the genera-group Phlaeobae, along with some twenty-nine other genera of that exceedingly complex and widely spread tropical and subtropical Old World assemblage. With representatives of the majority of these genera before me I proceeded to make a careful analysis of *Machaerocera* and *Holopercna* for evidence of relationship, and also of their position in relation to the other phlaeobid genera. As a result of this study it is clearly evident that *Machaerocera* is a New World relative of the African *Holopercna* and, on the basis of present group associations, a number of the hitherto Old World Phlaeobae.

When *Machaerocera* and *Holopercna* are compared it is seen they have the general form very similar, with numerous details of the head structure, such as that of the frontal costa and of the antennae, much the same, with similar basic alar, sternal and limb forms; and, further, they agree in the wing color pattern and the unusual discal color of the same. Noteworthy differ-

[7] Berlin Entom. Zeitschr., XXXVI, p. 176 (1891).
[8] An. Soc. Españ. Hist. Nat., XIX, p. 311 (1890).

ences of *Machaerocera* from *Holopercna* are: the fastigium, as seen from the dorsum, is more acutely produced with no definite discal carinula, the lateral foveolae are longer and more appreciable, reaching two-thirds of the distance to the apex of the fastigium as seen in profile, and also are shallowly excavate; the pronotum is more tectate and has the median carina somewhat more pronounced, cut by two sulci, instead of solely the principal one, while the lateral carinae are not sharply defined but are represented by marked shoulders, these broken at the principal sulcus, and on the prozona continuations of the shoulders subobsoletely descend ventro-cephalad across the lateral lobes as low ill-defined swellings (of which there are weak analogs in *Holopercna*), the caudal margin of the pronotal disk is rectangulately produced, while the surface of the metazona, and less definitely of sections of the prozona, bears scattered nodulose granules, as contrasted with the micro-cribrose subcoriaceous texture of *Holopercna;* the tegmina have the posterior axillary vein marked in both sexes and definitely joining the anterior axillary vein at two-fifths of the length of the anal field.

Unfortunately no chromosomal studies have as yet been made of *Holopercna,* but it is hoped this may soon be possible.

While we have a few approximately parallel patterns of genera-group distributions in the Orthoptera, such as the Sphenaria of the Pyrgomorphinae, which occurs in the Old World in Eastern Africa and the Oriental Region, and in America in Mexico and Central America, the presence in the latter areas of a relative of *Holopercna,* and hence a member of the Phlaeobae, which hitherto had been regarded as exclusively Old World, is of both systematic and zoogeographic interest.

The Larva of Pleocoma and its Systematic Position (Coleoptera, Pleocomidae) [1]

By Wm. P. Hayes and Peh-I Chang, University of Illinois

Introduction

Paulian (1941), in a study of adult characteristics, has attempted to settle the uncertainty of the relationships of the genus *Pleocoma* to other members of the superfamily Scarabaeoidea. He points out that the genus has been transferred from the Laparosticti to the Pleurosticti, that is, from the family Geotrupidae to the subfamily Dynastinae of the Scarabaeidae, and that authorities have not been in agreement on the systematic position of the genus. Arrow (1909, p. 484) placed *Pleocoma* in the subfamily Pleocominae and points out that *Pleocoma* and *Pachypus* have similar habits and "although by no means closely related are probably more nearly related to each other than to any other known forms, and that, while they are best classed among the Laparosticti, they are scarcely less related to the Pleurosticti." Böving and Craighead (1931) on the basis of larval characters have considered the genus as a subfamily, Pleocominae, of the Scarabaeidae, and Essig (1942) has considered *Pleocoma* as representing a new family, Pleocomidae. On the basis of Paulian's study of external adult characters and the male genitalia of *Pleocoma,* he believes the genus should be placed in a distinct subfamily the Pleocominae, in the family Geotrupidae. In the past a number of other workers have discussed the position of this genus. The two genera of the group, *Pleocoma* Le Conte and *Acoma* Le Conte are known only from the states of California, Washington, Oregon, Utah, Texas and probably Alaska. *Pleocoma* according to Essig contains 26 species.

The larva of *Acoma* is unknown, that of *Pleocoma* was illustrated and imperfectly described by Osten-Sacken (1874)

[1] Contribution No. 270 from the Entomological Laboratories of the University of Illinois, Urbana.

from a single specimen in the process of moulting.* Paulian (*l.c.*) has pointed out that larval characters which can be studied from Osten-Sacken's description and figures, because of their lack of detail, do not indicate the position of *Pleocoma*. He further noted that this larva does not approach the Lucanidae because the abdominal segments are divided into subsegments (annulets); nor can it be placed in the Pleurosticti because the maxilla has the galea and lacinia distinctly separated, whereas in Pleurosticti they are fused into a single structure (male).

Osten-Sacken (*l.c.*) concludes his description of the larva with the following comments on the relationships of *Pleocoma* based on a comparison of his larva with descriptions of *Geotrupes* and *Trox* by two European authors, "When I compare this larva with the analytical table of the lamellicorn larvae by Erichson, reproduced by Chapius (*Larves des col.*, p. 454), I find that it has the two separate maxillary lobes attributed to the Scarabaeidae Laparosticti; it has the segments divided by deep furrows into transverse bolsters, like the subdivision A in that table (Geotrupidae, Aphodiidae, Copridae, Trogidae). When I further compare our larva with the few existing descriptions of larvae of these groups, I soon perceive that the choice will lie between the Geotrupidae and Trogidae. The Aphodiidae and Copridae are excluded by the structure of their antennae, maxillae, labium, etc. Of those two groups we possess, as far as I am aware, only two good descriptions of larvae: Mulsant's of the larva of *Geotrupes stercorarius* and Chapius' of the larva of *Trox carolinus*. If we were to base our opinion upon these two descriptions only, it would incline in favor of a relationship of our larva with the Trogidae, rather than the Geotrupidae. Chapius' description of the larva of *Trox carolinus* agrees quite well with our larva; the description of the labium especially (lévre inférieure formée d'un menton et d'une piéce palpigére fondus en un real corps allongé) seems to indicate a structure somewhat analogous to that in our larva. On the contrary, Mulsant's description of the larva of *Geotrupes* disagrees with ours in several

* Since the present paper was sent to press, P. O. Ritcher has described the larva of *Pleocoma hirticollis vandykei* in Pan-Pacific Ent., 23: 11–20, (1947).

points. The antennae are said to be four-jointed, the maxillae to have two almost cylindrical lobes, the legs are described as bilobed at the end, etc. Finally, if it be true that the larva of *Geotrupes* has only two pairs of well developed legs, the third being almost atrophied, as Frisch (but not Mulsant) describes it, this would constitute another important difference."

Osten-Sacken in his discussion of this larva points out the "singular fact that the shape of the mandibles changes after moulting. A similar peculiarity has been already observed among larvae of other orders of insects. That the shape of the earlier mandibles is merely due to its being worn is a supposition that will hardly be entertained by any one who has compared the two mandibles."

Gerstaecker (1883) maintained that *Pleocoma* should be removed from the Scarabaeidae Laparosticti and placed in the Melolonthinae of the Scarabaeidae Pleurostici. He further asserted that the larva described by Osten-Sacken as *Pleocoma* cannot possibly belong to that genus nor to any genus allied to *Geotrupes,* and that it is undoubtedly a Lucanid. Gerstaecker's paper was translated by J. B. Smith and read at the November 18, 1885 meeting of the Washington Entomological Society (Proc. Wash. Ent. Soc., vol. 1, p. 32) and there the question was posed "what is the larva described by Osten-Sacken as that of *Pleocoma,* since there is no Lucanid known to occur in California which is of the size indicated by the larva." At the April 5, 1888, meeting of the same society (*l.c.,* p. 144), G. H. Horn criticized Gerstaecker's paper and stated that he believed the larva described by Osten-Sacken really belongs to *Pleocoma.*

A single specimen of an undetermined species of *Pleocoma* was available to the writers for study. It was collected at the roots of a pear tree at Camino, California, in November 1934 by R. H. Dart and was determined to the genus by him. Camino is in Eldorado County, California, and according to the distribution of this genus in California, as determined by Linsley (1938, p. 99), *Pleocoma fimbriata* Le Conte is the only species occurring in Eldorado County, and Linsley (p. 50) states that *fimbriata* "occurs commonly in the vicinity of Placerville, California." Camino is only a few miles east of Placerville. So it is quite probable that the species here described is *P. fimbriata* Le Conte.

Description of the Larva of Pleocoma

The third instar larva (fig. 2) which was available for study has a pale yellow head and whitish body. It is about 50 mm. long. The thoracic and first eight abdominal segments are dorsally divided into three annulets. The ninth abdominal segment is faintly divided dorsally into two segments and the tenth is undivided. The annulets are covered with minute setae on the dorsal surface. There are nine spiracles. One is located ventro-laterally on the prothorax and the other eight are on the first eight abdominal segments. The three pairs of thoracic legs are well developed. The anal slit (fig. 14) is T-shaped.

The Head. The head (fig. 6) is pale yellow in color in our preserved specimen. A Y-shaped epicranial suture divides the epicranium (EPI) and the epicranial arms are somewhat sinuate as they approach the bases of the antennae. A few scattered setae are located on the epicranium. The front (F) has a few setae on both sides of the mesal line. The clypeus (CLP) is much wider than long and is faintly divided into a preclypeus and postclypeus by a weak clypeal suture. The labrum (LAB) is roughly semicircular with a median projecting lobe on the anterior margin which gives the margin a trilobed appearance. The surface of the labium is rather densely setaceous.

The antennae (fig. 1) are three-segmented although a somewhat bulbous extension of the head capsule gives a four-segmented appearance. Some authors consider this bulbous part of the head to be an antennal segment but recent workers are inclined to disregard it as a segment. The first or basal segment is long and cylindrical, the second about the same length and the third is quite short, being about half as long as the second.

The epipharynx (fig. 5) is the ental aspect of the labrum and clypeus. Distally its margin is broadly trilobed. The median lobe projects quite prominently and is densely covered with long spinelike setae. The lateral lobes have two rows of long setae. Most of the entire surface is covered with setae which are generally pointing toward the median line. A small cluster of spines is located on the mesal area caudad of the median lobe. The

tormae (T) are located at the sides of the clypeo-labral suture. They are nearly symmetrical and become somewhat pointed near the meson. Proximally on the labrum and overlapping the clypeal area are two converging clusters of fine setae which become longer proximally and eventually seem to cross each other. On each side of these setae are very minute spine-like structures that may be sensory in function. Near the tormae and located in the cluster of dense setae are two sensory cones (SC). Near the median line in the region of the fronto-clypeal suture are two sensory spines and a broadly curved, strongly sclerotized rod-like structure. The trilobed condition of the epipharynx, but not the setal arrangement, of *Pleocoma* is somewhat similar to that of *Geotrupes* as figured by Schiödte. (See *Ill. Biol. Monog.* vol. 12, pl. 6, fig. 58).

The mandibles (fig. 11 and 13) are nearly symmetrical. They articulate on the head capsule by a tricondylic articulation. The molar area is small with a few blunt teeth. The scissorial area is smooth and blade-like with the distal end truncate. The ventral aspect has a cluster of small setae near the molar area and a cluster of longer setae, caudad of the molar area. The scissorial area near the curved part of the inner margin has a series of fine striae that may correspond to the stridulating area on the mandibles of other scarabaeid larvae. These may rasp against certain spine-like processes that are found on the maxillae (fig. 12, ST) immediately under these striae. There are a few, faint, longitudinal striae ventrally on the distal end of the scissorial region.

The maxilla (fig. 12) has a nearly quadrangular cardo (CD) and the stipes (S) bears on its dorsal surface (fig. 12) a longitudinal row of stridulating spines (ST) similar to those found in other scarabaeid species. The right maxilla has 10 spines (fig. 9, right) in the row while the left maxilla has twelve (fig. 9, left). These spines are narrowly triangular in shape. The palpifer (PF) bears a four-segmented palpus (MP) with segments of nearly equal length. The distal segment becomes attenuated near the end. The galea (G) and lacinia (LC) are not united into a single piece as they are in the Pleurosticti but are composed of two parts, at least distally, as is common in the

Laparosticti. The mesal margin of the lacinia is covered with numerous setae and the distal end has one large dark spine. The galea has a few setae distally and also one large spine.

The labium (fig. 10, LA) has a subquadrate submentum (SM). The mentum (M) is also subquadrate. The ligula (L) bears the labial palpi at its disto-lateral angles. The glossae and paraglossae are fused into a single sclerite which is located between the palpi. The labial palpus (LP) is two-segmented. The basal segment is wider than long and the second segment is nearly two times longer than wide.

The three segments of the thorax are about equal in size. Each is divided dorsally into three subsegments or annulets. The prothorax bears a spiracle on each side just above the prothoracic leg. The other two segments, the meso-, and metathoracic, are similar except that they lack the spiracles.

The Legs. The first two pair of legs (fig. 8) are much alike. There is an elongated coxa (C), a small, triangular trochanter (TR), a long femur (FM), a short, broad tibia (TB) and a sharply attenuated, one-segmented tarsus (TA) ending in a single claw (CL). On the mesothoracic leg (fig. 8) the coxa bears a plectrum or stridulating plate (STP) composed of a series of fine transverse striae. All the legs are densely setaceous. The metathoracic legs (fig. 2) are somewhat shorter and stouter than the first and second pair of legs. The coxa (C) is shorter, more nearly cylindrical and subtruncate at both ends and lacks the stridulating plate of the mesothoracic leg. The trochanter (TR) is small and the femur (FM) larger and strongly emarginate on the mesal margin. On the cephalic aspect of the femur of the metathoracic legs are two rows of spine-like tubercles (figs. 15 and 16), almost at right angles to each other. One row, lying in a longitudinal direction, is composed of 5 tubercles; the other row is basad of the longitudinal row and lies almost transversely across the base of the femur. Each tubercle has arising behind it near its base a single unbranched seta. The distal tubercle of the transverse row is exceptional in that its seta is branched (fig. 16). These rows of tubercles correspond to the rows of stridulating spines found in some other Scarabaeoidea. It is interesting to note that this

stridulating structure, if such it be, is different in arrangement than that found in the Passalidae and Geotrupidae wherein the metathoracic leg is greatly reduced in size and serves only as a rasping paw and lacks several of the leg segments. Distad of the femur on metathoracic leg is a small subquadrate tibia (TB) which in turn bears, distally, a much narrower one-segmented tarsus (TA) and a single claw.

The abdomen is ten-segmented. There are eight pairs of abdominal spiracles (fig. 3 and 4) on the first eight segments. The first eight dorsal segments are each subdivided into three subsegments and are rather densely and minutely spinose with a few scattered longer setae. The ninth and tenth segments are smooth and not strongly subdivided. The ninth has a faint transverse depression. The ventral aspect of the first eight segments is subdivided irregularly into at least two subsegments. The ninth and tenth are not subdivided and only indistinctly separated laterally from the dorsal area. The anal slit (fig. 14, ANS) is T-shaped, giving a trilobed appearance to the caudal end of the tenth segment.

The ventral aspect of the tenth abdominal segment (fig. 14), called the raster or radula, is not strongly developed. A faint transverse depression is located near the distal end and between it and the anal opening are numerous small setae. Cephalad of this depressed line are a few scattered setae but most of the remaining area is non-setose.

The spiracles are broadly oval with the long axis lying longitudinally. The first spiracle (fig. 4) located on the prothorax is smaller and more narrowly oval than the others (fig. 3). The dorsal part of each spiracle is a moon-shaped area with numerous perforations, the so-called "sieve plate." The ventral half is a quite smooth peritreme. There apparently is no slit-like opening nor a raised bulla as is found in the spiracles of some scarabaeid larvae.

Discussion of Larval Relationships

According to Paulian (1939, p. 356), Arrow was the first to propose raising the subfamily Geotrupinae to the rank of a distinct family equivalent to that of the Lucanidae and Passalidae.

This change was not recognized by others until Böving and Craighead (1931, p. 52) on the basis of larval characters again recognized the subfamily Geotrupinae as a family. These authors, however, placed the genus *Pleocoma* in a subfamily of the Scarabaeidae, called the Pleocominae. Paulian (1939) has discussed the larval and adult characters of *Geotrupes niger* Marsh. and concludes, as Arrow did, that *Geotrupes* should be regarded as of family rank. In a more recent paper, Paulian (1941), principally on the basis of adult characters, believes *Pleocoma* should be regarded as representing a subfamily of the Geotrupidae.

Paulian (1941) further states that Osten-Sacken's (*l.c.*) description of the larva of *Pleocoma* does not permit placing it definitely because the description is imperfect. It does, however, indicate, according to Paulian, that it does not belong with the Lucanidae because the abdominal tergites are divided transversely, nor with the Pleurosticta Scarabaeidae because the galea

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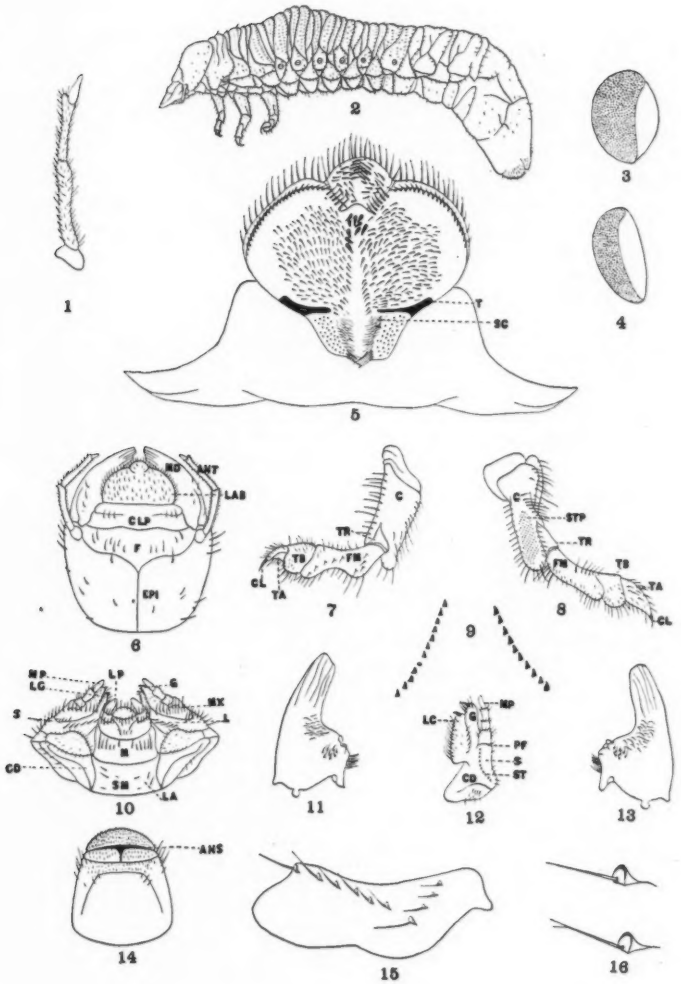
EXPLANATION OF PLATE I

Structural Parts of the Third Instar Larva of *Pleocoma*

1. Antenna. 2. Lateral aspect of third instar larva. 3. Abdominal spiracle. 4. Thoracic spiracle. 5. Epipharynx or ental aspect of the labrum and clypeus. 6. Cephalic aspect of the head. 7. Metathoracic leg. 8. Mesothoracic leg. 9. Stridulating teeth on the stipes of the right and left maxillae. 10. Labium and maxillae. 11. Caudal aspect of the right mandible. 12. Cephalic aspect of the right maxilla. 13. Caudal aspect of the left mandible. 14 Ventral aspect of last abdominal segment (raster). 15. Cephalic aspect of metathoracic femur showing stridulating teeth and associated setae. 16. Two stridulating teeth enlarged to show a single and a branched seta.

EXPLANATION OF ABBREVIATIONS

ANS—Anal slit
ANT—Antenna
C—Coxa
CD—Cardo
CL—Claw
CLP—Clypeus
EPI—Epicranium
F—Front
FM—Femur
LA—Labium
LAB—Labrum
LC—Lacinia
LP—Labial palpus
M—Mentum
MD—Mandible
MP—Maxillary palpus
MX—Maxilla
PF—Palpifer
S—Stipes
SC—Sense cone
SM—Submentum
ST—Stridulating spines
STP—Stridulating plate
T—Torma
TA—Tarsus
TB—Tibia
TR—Trochanter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and lacinia of the maxillae are separated and not fused into a single mala. Essig (1942), on the other hand, considers *Pleocoma* as representing a distinct family which he calls the Pleocomidae.

On the basis of larval characters described herein it seems that *Pleocoma* is sufficiently different from *Geotrupes* and others to merit being placed as a separate family, Pleocomidae, principally on the degree of development of the stridulating legs and on the basis of other structures such as the mandibles and epipharynx. The posterior legs of *Geotrupes*, which are used for stridulating, are reduced in size as in the Passalidae but not to the extent that they are in the Passalidae. Those of *Pleocoma* are fully developed as are those of the Lucanidae. The rasping spines on the metathoracic leg of Geotrupidae are well developed while those in *Pleocoma* (fig. 15) have long setae associated with them that might make them less efficient. The mandibular-maxillary stridulating structures are well developed in the Scarabaeidae and poorly developed or absent in the Geotrupidae and Lucanidae. In this respect, *Pleocoma* seems to represent an intermediate condition in that the striae of the mandibular stridulating area are poorly developed while the maxillary stridulating teeth (fig. 9) are well developed. Hence it is probable that these structures do not function to produce stridulation in *Pleocoma*. In this respect they approach the Geotrupidae.

The mandibles of *Geotrupes* bear strongly developed teeth on the scissorial area which Paulian calls a "double retinaculum," while *Pleocoma* lacks any such teeth and has a smooth cutting area. The epipharynx is trilobed in both *Geotrupes* and *Pleocoma* but seems more highly developed in *Geotrupes*. The faint division of the ninth abdominal segment of *Pleocoma* into subsegments indicates a trend toward the Scarabaeidae rather than the smooth undivided segments found in Lucanidae and Passalidae. From the above differences of the larva it seems to the writers that the raising of the subfamily Pleocominae to family rank is justifiable and more logical than regarding it as a subfamily of Geotrupidae.

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Notes on the Genus Somatochlora Collected in Kentucky and Tennessee (Odonata: Cordulinae)

By CARL COOK, Crailhope, Kentucky

In 1941 and again in the 1946 collecting season the writer made an especial effort to collect as many species of the genus *Somatochlora* as possible from Kentucky and Tennessee. Most of the collecting was done in central and eastern Kentucky and southeastern Tennessee, chiefly in the Great Smoky Mountains National Park.

Seventeen specimens representing five species were taken and several others were seen but could not be captured. It is well known that these dragonflies are notoriously difficult to capture, as they often fly back and forth for hours at a time, keeping

to a height of ten to twenty-five, often fifty, feet. Under such circumstances the collector finds a net almost useless; a much more useful piece of equipment for bringing down the high flyers is a shotgun and the finest possible shot. For several years the writer has been using a 20-gauge Model 12 Winchester with 20 in. barrel fitted with Cutts "compensator" to reduce muzzle blast from the short barrel. The best shot to use is known as dust-shot, which is of very small size; most dragonflies brought down with this size shot will be usable as cabinet specimens, and all are valuable for purposes such as this survey.

Our species of *Somatochlora* inhabit chiefly the colder areas of the United States and Canada, and with few exceptions are to be found in the southern states only in the more mountainous parts. It is in these mountainous areas that the writer has done most of his collecting and whence all the more interesting specimens were secured.

One species is being recorded for the first time south of Pennsylvania and a few others are recorded for the first time from the territory covered by this paper. It has always been assumed that these species could be found in Kentucky and Tennessee but there were no authentic records of their ever being collected there. In the following list of species collected, an effort has been made to add a few notes on the collecting areas visited by the writer and to point out some of the habits of these very interesting dragonflies, as well as to list date and locality data.

Somatochlora linearis Hagen

KENTUCKY: Donansburg, 1 ♂, 1 ♀, July 10, 1941; 1 ♂, Aug. 29, 1946; Crailhope, 1 ♂, June 19, 1941; 1 ♂, July 20, 1946; Somerset, 1 ♂, Aug. 6, 1946; Mammoth Cave National Park, 1 ♂, July 4, 1946; Hardyville, 1 ♂, Sept. 3, 1946.

TENNESSEE: U. S. 35, 6 miles south of Knoxville, 1 ♂, July 11, 1946.

This seems to be the commonest species of the genus in Kentucky. At Donansburg it was not uncommon to find the males coursing up and down a small stream in a manner suggestive of

Aeschna males. The stream flows through the center of an open, pastured meadow and at dusk they like to leave the stream and fly about over the meadow at a height of twenty to thirty feet. At a small clearing in a woodland area bordering U. S. Highway No. 35, just out of Knoxville, Tenn., five or six were patrolling back and forth at about 10:00 A.M.; one was taken but the others retired and had not returned when we left the clearing at 11:30 A.M.

Somatochlora tenebrosa Say

KENTUCKY: Jenkins, Letcher Co., 1 ♂, July 30, 1941; Prestonsburg, Floyd Co., 1 ♂, July 15, 1946.

So far this species has been taken only in the more mountainous parts of eastern Kentucky. It does not seem to be common in any of the areas visited by the writer; none were seen in the Great Smoky Mountains National Park.

One was flying fifteen or twenty feet high over an overgrown field, about 200 yards up from Levisa Fork River near Ky. Highway No. 80, 10 miles south of Prestonsburg. It was taken with great difficulty, since the writer was equipped with only a net at the time, which was just after sunset. *S. tenebrosa* is said to be crepuscular and this is apparently true of the examples seen by the writer, both his specimens having been taken after sunset.

Somatochlora provocans Calvert

KENTUCKY: Crailhope, Green Co., 1 ♂, June 28, 1946. TENNESSEE: Mt. Le Conte, Great Smoky Mountains National Park, 1 ♂, July 12, 1946.

My first example of this species was taken while it was patrolling at the usual height, over an old, unused, overgrown road in full sunshine at about 2:30 P.M. It seemed very determined to keep at its patrolling as two or three passes at it with the net failed to drive it away; finally, a lucky stroke with the net brought it down. The second specimen was taken at one of the most interesting and unusual collecting localities visited by the writer in this survey, Mt. Le Conte (6,593 ft.). It was

here that we found also the northern *williamsoni*, on the same day and within 100 yards of the place where this specimen of *provocans* was taken.

The collecting ground here consists of an open pine woods bordering each edge of Le Conte Creek. Most of the collecting was done from near the source of this stream on down for a mile or more of its course. Near the headwaters of this stream and some 100 yards from its banks two brownish dragonflies were flushed from an uprooted tree. One after flying about in the woods for a few moments came back to the tree and lit again; it was taken immediately and turned out to be a fine male of *provocans*.

Somatochlora filosa Hagen

KENTUCKY: Mammoth Cave National Park, 1 ♂, June 27, 1941.

TENNESSEE: Nashville, 1 ♂, June 2, 1941; Spencer, Van Buren Co., 1 ♂, July 6, 1946.

This species has a very wide range in the southern and eastern states, Illinois and New Jersey to Florida. Therefore, it is not surprising that it occurs quite frequently in the territory covered by this paper.

My first chance at this species came one hot, humid, June afternoon in the Mammoth Cave National Park. On entering a large grove of tall oaks where the ground was shaded by the dense wide-spreading trees, I flushed a pair in copula from the trunk of one of the oaks. They immediately lit on the trunk of another tree but this time at a height of about twenty feet. As my shotgun was not at hand, the only solution was to climb the tree. This would have been difficult to do while carrying a net, so I decided to climb the tree from the opposite side from where they were hanging by their feet on a small twig and to try to get them with my fingers. The male was caught successfully but the female escaped.

At sunset several specimens were in active flight, soaring high over the tree tops in a park near the campus of Vanderbilt Uni-

versity, Nashville, Tenn. Occasionally one would swoop lower in pursuit of some small insect on which they were feeding. Only one could be taken, and it with great difficulty.

Somatochlora williamsoni Walker

TENNESSEE: Le Conte Creek, Mt. Le Conte, Great Smoky Mountains National Park, 1 ♂, July 12, 1946.

This is a significant extension to the known geographic range of this species; so far as known this is the first record of *williamsoni* being taken south of Pennsylvania. Its presence here is probably explained by the high altitude of the Great Smoky Mountains in the region where it was found; the altitude of Mt. LeConte is 6,593 feet. At the place where it was taken, Le Conte Creek is not very wide and the banks on both sides are partly shaded. It was first noticed on July 11th, while it was patrolling back and forth at a height of a foot or so, near the shaded bank of the creek. It was wild and unapproachable and at the first sign of danger went across to the other side of the creek out of my reach, however, after several moments of patrolling that bank it came back over on my side again. One wild swish with the net caused it to retire and not return that afternoon. Next day it was back at its patrolling over the same area of the creek. It had a habit of "marking time" in the air much in the manner of *Cordulia surtleffi*, so my opportunity for capture came at one of these haltings. It was caught off guard for an instant, a swift swing with the net and . . . it was mine!

Current Entomological Literature

COMPILED BY EDWIN T. MOUL, RAYMOND Q. BLISS, CHARLES HODGE IV, MAURICE E. PHILLIPS, JOHN W. H. REHN AND HENRY K. TOWNES, JR.

Under the above head it is intended to note papers received at the Academy of Natural Sciences of Philadelphia and the University of Pennsylvania, pertaining to the Entomology of the Americas (North and South), including Arachnida and Myriopoda. Articles irrelevant to American entomology will not be noted; but contributions to anatomy, physiology and embryology of insects, however, whether relating to American or exotic species will be recorded.

This list gives references of the current or preceding year unless otherwise noted. Continued papers, with few exceptions, are recorded only at their first installment.

For records of Economic Literature, see the Experiment Station Record, Office of Experiment Stations, Washington. Also Review of Applied Entomology, Series A, London. For records of papers on Medical Entomology, see Review of Applied Entomology, Series B.

NOTE: The figures within brackets [ ] refer to the journal in which the paper appeared, as numbered in the List of periodicals and serials published in our January and June issues. The number of the volume, and in some cases, the part, heft, &c. is followed by a colon (:). References to papers containing new forms or names not so stated in titles are followed by (*); if containing keys are followed by (k); papers pertaining exclusively to Neotropical species, and not so indicated in the title, have the symbol (S).

Papers published in ENTOMOLOGICAL NEWS are not listed.

GENERAL—Dustan, G. G.—Effect of temperature on toxicity of DDT. [23] 79: 1–4. **Frings, H.**—A simple method for rearing blowflies without meat. [80] 105: 482. **Macan, T. T.**—Taxonomy of aquatic insect nymphs and larvae. [53] 159: 595–96. **Pennak, R. W.**—Keys to aquatic insects of Colorado. [Univ. of Col. Studies, Ser. D., Boulder] 2: 353–83. **Sabrosky, C. W.**—The significance of the "editorial notes" in the reprints of the earlier opinions on zoological nomenclature. [5] 40: 152–53. **Wachs, H.**—Synergistic insecticides. [80] 105: 530–31. **Weiss, H. B.**—Entomological medicaments of the past. [45] 55: 155–68.

ANATOMY, PHYSIOLOGY, MEDICAL—Beament, J. W. L.—The formation and structure of the micropylar complex in the egg-shell of Rhodnius prolixus (Reduviidae). [40] 23: 213–33, ill. **Bick and Penn**—Resistance of mosquito larvae and pupae to experimental drought. [5] 40: 82–86. **Bodine and Fitzgerald**—A spectrophotometric study of a developing egg (Orthoptera) with especial reference to riboflavin and its derivatives. [41] 104: 353–63. **Carbonell, C. S.**—The thoracic muscles of the cockroach Periplaneta americana. [82] 107: 1–23, ill. **Demerec, M.**—Mutations in Drosophila induced by a carcinogen. [53] 159: 604. **Dobzhansky, T.**—A response of certain gene arrangements in the third chromosome of Drosophila pseudoobscura to natural section. [Genetics, N. Y.] 32: 142–60. **Dubinin and Tiniakov**—Inversion gradients and selection

in ecological races of Drosophila funebris. [3] 81: 148–53. **Farnsworth, M. W.**—The morphology and musculature of the larval head of Anopheles quadrimaculatus. [5] 40: 137–51, ill. **Fish, W. A.**—Embryology of Lucilia sericata (Calliphoridae): I. Cell cleavage and early embryonic development. [5] 40: 15–25, ill. **Gregson, J. D.**—Benzene hexachloride ("666") as an acaricide. [23] 78: 201–02. **Morgan, L. V.**—A variable phenotype associated with the fourth chromosome of Drosophila melanogaster and affected by heterochromatin. [Genetics, N. Y.] 32: 200–19. **Patterson, J. T.** (editor)—Studies in the genetics of Drosophila. V. Isolating mechanisms. [Univ. of Texas Publ., Austin] 4720: 7–184. **Slack, H. D.**—Feeding mechanism of water-bugs. [53] 159: 605, ill. **Trager, W.**—Insect nutrition. [Biol. Rev., Cambridge Phil. Soc., Eng.] 22: 148–77. **Viette, P.**—Les Hepiales. [Rev. Française de Lepidopterologie] 10: 366–70, ill.

ARACHNIDA AND MYRIOPODA—Archer, A. F.—The Theridiidae or comb-footed spiders of Alabama. [Geol. Surv. of Alab., Univ. of Alab.] Museum Paper 22: 5–67, ill. (k). **Baker, E. W.**—Notes on mites of the family Tydeidae with descriptions of two new species. [65] 49: 133–36, ill. **Chamberlin and Ivie**—North Amer. Dictynid spiders: The Bennetti group of Amaurobins. [5] 40: 29–55, ill. (k*). **Gregson, J. D.**—(See under Anatomy.) **Hoff, C. C.**—The species of the pseudoscorpion genus Chelanops described by Banks. [20] 98: 473–550, ill.; Two new pseudoscorpions of the subfamily Lamprochernetinae from Venezuela. [95] 32: 61–64, ill. **Jameson, E. W., Jr.**—The geographic range of Ixodes soricis. [23] 78: 200. **Jenkins, D. W.**—A laboratory method of rearing chiggers affecting man (Trombiculidae). [5] 40: 56–68, ill. **Michener and Michener**—Chiggers. [56] 56: 231–35, ill. **Smith and Gouck**—Ixodes bishoppi, a new species from Georgia. [5] 40: 75–81, ill.

THE SMALLER ORDERS—Calvert, P. P.—Aeshna psilus, a new species of the group of Ae. cornigera Brauer (Odonata). [109] 194: 1–11, ill. (k). **Carpenter, F. M.**—Lower permian insects from Oklahoma. Part I. Introduction and the orders Megasecoptera, Protodonata, and Odonata. [Proc. Amer. Acad. Arts and Sciences, Boston] 76: 25–54, ill. (*). **Denning, D. G.**—Hydroptilidae (Trichoptera) from southern U. S. [23] 79: 12–20, ill. (*). **Froeschner, R. C.**—Notes and keys to the Neuroptera of Missouri. [5] 40: 123–36, ill. (k). **Hopkins, G. H.**—Stray notes on

Mallophaga. VII. [6] 13: 170–183, ill. (*). **Matthysse, J. G.**—Cattle lice, their biology and control. [Cornell Univ., Agr. Exp. Station] 832: 3–67, ill. **Spieth, H. T.**—Taxonomic studies of the Ephemeroptera. IV. The genus Stenonema. [5] 40: 87–122, ill.

ORTHOPTERA—Bodine and Fitzgerald—(See under Anatomy.) **Carbonell, C. S.**—(See under Anatomy.)

HEMIPTERA—Anderson, R. F.—Saratoga spittle-bug injury to pine. [37] 40: 26–33, ill. **Beament, J. W. L.**—(See under Anatomy.) **Caldwell, J. S.**—New Fulgoroidea from North America. [58] 47: 76–78. **China, W. E.**—A new species of the genus Arachnocoris with a key to the known species of the genus (Nabidae). [6] 13: 119–22, ill. (kS*). **Fennah, R. G.**—A synopsis of the Archilixiidae of the New World (Fulgoroidea). [6] 13: 183–91, ill. (k*). **Slack, H. D.**—(See under Anatomy.)

LEPIDOPTERA—Bell, E. L.—A new species of Hesperiidae from Venezuela. [95] 32: 67–68, ill. **Rau, P.**—Butterfly aggregations in temperate regions. [5] 40: 13–14. **Viette, P.**—(See under Anatomy.)

DIPTERA—Alexander, C. P.—Records and descriptions of neotropical crane-flies (Tipulidae). XXII. [45] 55: 173–84. **Bates, M.**—The development and longevity of Haemagogus mosquitoes under laboratory conditions. [5] 40: 1–12. **Bick and Penn**—(See under Anatomy.) **Brescia, F.**—A study of the migratory habits of salt marsh and anopheline mosquitoes. [5] 40: 69–74. **Bromley, S. W.**—Ohio robber flies. IV. (Asitidae). [58] 47: 67–68. **Demerec, M.**—(See under Anatomy.) **Dobzhansky, T.**—(See under Anatomy.) **Dodge, H. R.**—A new species of Wyeomyia from the pitcher plant (Culicidae). [65] 49: 117–22, ill. **Dubinin and Tiniakov**—(See under Anatomy.) **Farnsworth, M. W.**—(See under Anatomy.) **Fish, W. A.**—(See under Anatomy.) **Frings, H.**—(See under General.) **Michener, C. D.**—Mosquitoes of a limited area in so. Mississippi. [1] 37: 325–74. **Morgan, L. V.**—(See under Anatomy.) **Olsen and Davies**—The story of Syrphus weidemanni, a fly magnified in plastic. [45] 55: 107–13. **Patterson, J. T., ed.**—(See under Anatomy.) **Phillip, C. B.**—A catalogue of the blood-sucking fly family Tabanidae of the nearctic region n. of Mexico. [1] 37: 257–324 (k). **Rapp, W. F., Jr.**—Separation of adult Psychoda and Pericomal (Psychodidae). [45] 55: 169–71, ill. **Shaw, J. G.**—

Hosts and distribution of Anastrepha serpentina in n.e. Mexico. [37] 40: 36–40. **Weiss, H. B.**—Dry-cleaning fluid and the kelp-fly. [45] 55: 114; Smoke flies. [45] 55: 146.

COLEOPTERA—Anderson, W. H.—A terminology for the anatomical characters useful in the taxonomy of weevil larvae. [65] 49: 123–32, ill. **Bird, R. D.**—Sweetclover weevil, Sitona cylindricollis. [23] 79: 5–11. **Knull, J. N.**—New North American Coleoptera (Buprestidae, Schizopodida and Cerambycidae). [58] 47: 69–73, ill. **Leech, H. B.**—Collecting in southern British Columbia; Finding of the water beetle, Deronectes spenceri. [23] 78: 198–200; Crow eating serica beetles (Scarabaeidae). [23] 79: 4. **Marshall, M. Y.**—Studies in the Malachiidae. [23] 78: 183–95 (k*).

HYMENOPTERA—Banks, N.—Studies of S. Amer. Psammocharidae. Part II. [20] 99: 371–486, ill. (k*). **Burks, B. D.**—Nearctic species of the genus Dirhinus (Chalcididae). [65] 49: 136–40, ill. (k*). **Enzmann, J.**—New forms of Aphaenogaster and Novomessor. [45] 55: 147–53, ill. (k*). **Gregg, R. E.**—Altitudinal indicators among the Formicidae. [Univ. of Col. Studies, Series D, Boulder] 2: 385–403. **Pate, V. S. L.**—A conspectus of the Tiphiidae, with particular reference to the nearctic forms (Aculeata). [45] 55: 115–45, ill. (k*); A minute on Paramyrmosa Saussure (Tiphiidae). [23] 78: 196–97 (k). **Timberlake, P. H.**—A revision of the species of Exomalopsis inhabiting the U. S. (Apoidea). [45] 55: 85–106 (k*).

EXCHANGES

This column is intended only for wants and exchanges, not for advertisements of goods for sale or services rendered. Notices not exceeding three lines free to subscribers.

These notices are continued as long as our limited space will allow; the new ones are added at the end of the column, and, only when necessary those at the top (being longest in) are discontinued.

Wanted—Oriental Cerambycidae and Chrysomelidae for determination and research purposes: China, India, Philippines, Pacific. Will purchase from China, Assam, Burma, Siam, Formosa. Will exchange identified Chinese insects. J. Linsley Gressitt, Lingnan University, Canton, China.

Wanted—Papers on Cicindelidae of any part of the world, especially South America and Pacific. R. G. Dahl, 3225 Grand Ave., Apt. 13, Oakland 10, Cal.

Chrysididae—Wanted for determination in preparation of revision. Wm. G. Bodenstein, Galesville, Maryland.

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Wanted—Ataenius and allied Aphodiinae from all parts of the world, especially Mexico, Central and South America. O. L. Cartwright, Clemson, S. C.

Wanted—Reprints and unpublished mss. on biological control of mosquitoes; for preparing annotated bibliographies for publication. J. B. Gerberich, Michigan State College, East Lansing, Mich.

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Hymenoptera-Aculeata (except ants and bees) for exchange. Will collect other orders in exchange. N. F. de Andrade, Casal Novo, S. João do Estoril, Portugal.

Meliponidae—Wanted, information on the bionomics, culture, and economic importance of the stingless bees, particularly of the Old World. P. Nogueira Neto, Av Cicade Jardim 170, S. Paulo, Brasil.

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1130.—Robinson (M.)—Studies in the Scarabaeidae III (72: 49–59, 1946) ..... .30

LEPIDOPTERA

1125.—Jones (F. M.)—Platoeceticus Packard, and a remarkable n. sp. of the genus (Psychidae) (71: 99–124, 4 pls., 1945) .... .75